Observations of Molt in an Endangered Rallid, the Hawaiian Moorhen

David W. DesRochers,1,3 Luke K. Butler,1 Michael D. Silbernagle,2 and J. Michael Reed1

ABSTRACT.—We used field and museum data to describe timing of flight feather molt in the endangered Hawaiian Moorhen (Gallinula chloropus sandvicensis). We evaluated 80 adults captured a total of 107 times at two study sites on Oahu from April 2005 to August 2007. Eighty-five of the birds were not molting, 13 had abraded remiges, and eight of the nine molting adults examined were simultaneously replacing their primaries, secondaries, and upper and lower wing coverts. We also scored molt for 28 Hawaiian Moorhen specimens from three museum collections, but no birds were molting. Molt in Hawaiian Moorhens, which lasts about 30 days, was not synchronous across individuals with molting birds recorded from June to September in the field. We observed non-molting individuals throughout the year including birds we captured and museum specimens. Molting and non-molting birds had similar body condition, as defined by mass/tarsometatarsal length. The flightless period during molt, which likely lasts about 25 days, may increase predation risk, a serious concern in Hawaii where introduced terrestrial predators pose a major threat to moorhen populations. Received 8 May 2008. Accepted 2 July 2008.

Understanding avian molt patterns is important because birds require significant energetic and protein resources to produce the new plumage (Panek and Majewski 1990, Earnst 1992, Murphy and King 1992, Bonier et al. 2007). Birds experience decreased flight performance during replacement of wing and tail feathers (Swaddle and Lockwood 2003). Some rallids and waterfowl replace all of their flight feathers simultaneously (Hohman et al. 1992, Taylor 1998) which, in some species can leave a bird flightless for >5 weeks (e.g., Summers 1983). Predation risk may be particularly high for species that exhibit this molt pattern (Panek and Majewski 1990). Consequently, many species exhibiting simultaneous replacement of flight feathers migrate to molt in refugia that provide both high food resources and low predation risk (e.g., Taylor 1995, Stout and Cooke 2003).

We describe flight feather molt in the volant Hawaiian Moorhen (Gallinula chloropus sandvicensis), a rallid listed as endangered under the U.S. Endangered Species Act and which is restricted to coastal wetlands on the islands of Kauai and Oahu (Taylor 1998, U.S. Fish and Wildlife Service 2005). Little is known about how, when, or where molt occurs in this species. Basic molt information has been published on the European (G. c. chloropus) and African (G. c. meridionalis) subspecies (Grant 1914, Fagan et al. 1976), but it is unknown whether individual or seasonal patterns are consistent across subspecies. Our objectives were to: (1) report numbers of primaries, secondaries, and rectrices, (2) estimate the duration of flightlessness and molt, (3) describe the timing of molt, and (4) test for differences in body condition between molting and non-molting birds. We also discuss molt in relation to the behavioral ecology and conservation of this species because, when birds are flightless, they are incapable of short, eruptive flights, which is one of their primary predator-escape tactics (Bannor and Kiviat 2002).

METHODS

Field Data.—Birds were captured from April 2005 to July 2007 (with the exception of Jun–Jul 2006) at James Campbell National Wildlife Refuge (James Campbell) (21° 41’ N, 157° 55’ W) and Waimea Falls Audubon Center (Waimea) (21° 38’ N, 158° 63’ W), which are both on Oahu. We categorized primaries as abraded, absent, growing, or completely new (fresh without sheath remnant) from June.
to July 2007. It was necessary to score molt rapidly because of strict handling time limitations on these endangered birds. We approximated completeness of molt remiges in increments of 25% (e.g., 0–25, 26–50%, etc.) to shorten handling time, adapting the method of Newton (1966). We scored secondaries, tertials, rectrices, wing and rectrix coverts, and body and head feathers as molting or not molting.

**Museum Data.—** We investigated molt in museum specimens at the Harvard Museum of Comparative Zoology \( n = 12 \), American Museum of Natural History \( n = 9 \), and the Smithsonian National Museum of Natural History \( n = 7 \). Specimens were collected across the species’ historic range (Hawaii, Kauai, Maui, Molokai, and Oahu) from the 1890s to 1900s with a single specimen collected in 1981. We also counted numbers of primaries, secondaries, and rectrices on two moorhen carcasses provided by the U.S. Geological Survey in Hawaii.

We estimated duration of flightlessness and calculated this period using an equation developed for ducks \( n = 8 \) species, \( r = 0.97 \) (Dean 1978): duration of flightlessness (in days) = 0.071·wing length (mm) + 13.45. Wing length refers to wing chord length (based on Dean’s [1978] wing length data and Madge and Burn [1988]). We used mean wing chord length from wild adults captured in our study to calculate the duration of flightlessness for Hawaiian Moorhens. We used the longest value when we had multiple measurements from the same individual, assuming that shorter measurements reflected feather wear. We estimated duration of molt using the mean length of the longest primary (P8) from two adult Hawaiian Moorhens, an average growth rate for moorhen primaries of 5.15 mm/day (Fagan et al. 1976), plus 2 days required for blood quills to emerge after feather shedding (Panek and Majewski 1990). We gathered data on when birds were molting during the year, but our research protocol did not allow for uniform capture effort across the year.

We tested the hypothesis that mean body condition index \( \text{BCI} = \text{body mass/tarsometatarsal length} \) (Freeman and Jackson 1990) of molting birds differed from non-molters. We made two separate comparisons of BCI because we did not know precisely when birds with highly abraded feathers would begin molting. We first compared BCI between molting and non-molting birds, including those with abraded feathers, and then combined molting birds and those with abraded feathers. We excluded a bird from analysis if a subsequent capture occurred within 30 days to ensure sample independence. We used a \( t \)-test (proc ttest) in SAS Version 9.1.3 to compare BCI.

There might be concern that growing neighboring feathers represent replacement of accidentally-lost feathers rather than replacement as part of a simultaneous molt. This did not appear to be a problem because we presumed that symmetrical wing feather replacement was unlikely to be accidental, and all wing molters were replacing feathers on both wings. In addition, one of two birds molting rectrices was also molting other regions of the wings or body symmetrically. Thus, we presumed this bird was in molt and not replacing accidentally-lost feathers.

**RESULTS**

We captured 80 adult moorhens, and recaptured 19 at least 30 days apart (range: 2–4 recaptures/individual) for a total of 107 captures. Eighty-five of 107 adults captured were not molting, 13 had abraded remiges, and nine were molting. We captured molting moorhens from June to September and birds with highly abraded feathers in February, May, June, August, and October to December. We also caught non-molting adults in every month except March (Fig. 1). Images of molting and non-molting birds, and individuals with abraded feathers can be viewed at http://ase.tufts.edu/biology/labs/reed/res-pub-suppl.html.

We scored primary molt for 11 adults captured at James Campbell from June to July 2007. Six of the birds did not appear to be molting, and the other five were in various stages of molt (Table 1). One of the five molting birds had abraded remiges and was molting some of its rectrices. Two birds were simultaneously molting their remiges (<25% complete), including all upper and lower wing coverts. One of these two molters had remiges growing simultaneously while the second bird’s remiges and coverts were not being replaced in a systematic order. The two other moorhens had completed the majority of their
FIG. 1. Molt status of Hawaiian Moorhens captured at James Campbell National Wildlife Refuge and Wai-
mea Valley Audubon Center, Oahu, Hawaii, and museum specimens from Harvard Museum of Comparative
Zoology, American Museum of Natural History, and Smithsonian National Museum of Natural History. Closed
circles = molting birds, half-circles = birds with worn remiges, and open circles = non-molting birds.

TABLE 1. Qualitative assessment of molt for five adult Hawaiian Moorhens captured at James Campbell
National Wildlife Refuge. Molt score adapted from Newton (1966) is given for left and right primaries. Values
were the same for the left and right wings. Yes = molt was between 0 and 100% complete. No = no discernable
sign of current or recent molt.

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<th>Primaries</th>
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<th>Tertials</th>
<th>Wing coverts</th>
<th>Rectrices</th>
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<td>Yes</td>
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molt with only the undertail coverts still growing, and all other feathers new. One non-molted bird had new flight feathers and no sheath wax was present, three had recently completed molt, which was apparent from the sheath wax found throughout the birds’ plumage, and two had exceptionally abraded flight feathers.

We observed slight to moderate wear on flight feathers for 12 of 28 (43%) moorhens in museum collections; 10 had no noticeable feather abrasion, and six birds were missing date of collection. Specimens with light to moderately abraded wing feathers, faded tips, and bars missing from about the distal 1 cm of rachis occurred in every month except July and September (Fig. 1).

Hawaiian Moorhens have 10 primaries, eight secondaries (confirmed by investigating ulnar attachment points), and 12 rectrices. Mean adult moorhen wing chord length (not flattened) was 170.8 ± 8.7 mm (± SD; n = 80 birds). We estimated that moorhens would be flightless for 25 days after molting their flight feathers using this value. We estimated that molt would take 30 days to complete based on an average length of primary 8 of 142.2 ± 1.2 mm (n = 4 feathers from 2 birds).

There was no significant difference in mean body condition between molting and non-molting birds. The BCI for non-molting + abraded feathers was 5.68 ± 0.68, n = 98, while BCI for molting birds was 6.01 ± 1.07, n = 9 (t_{90} = -1.31, P = 0.19). The BCI for non-molting birds was 5.59 ± 0.82 (mean ± SD), n = 85, and for molting + abraded feathers: 5.24 ± 1.20, n = 22 (t_{21} = 0.70, P = 0.48).

**DISCUSSION**

Hawaiian Moorhens typically molt all of their flight feathers and associated wing coverts simultaneously; all but one bird in our study with molting flight feathers was molting them simultaneously. This is consistent with the simultaneous flight feather molt reported for European and African subspecies of Common Moorhen (*G. c. chloropus* and *G. c. meridionalis*) (Grant 1914, Fagan et al. 1976, Cramp and Simmons 1980). Numbers of the different types of flight feathers of Hawaiian Moorhens are within the range reported for other rail species (Proctor and Lynch 1993).

Molt in Hawaiian Moorhens, based on our data, appears to occur primarily from June through September. One possible explanation for this timing is that molt in Hawaiian Moorhens may follow breeding, as has been observed in northern populations of the European subspecies of Common Moorhen, where breeding is seasonal (Cramp and Simmons 1980). Post-breeding simultaneous flight feather molt also occurs in other rallids (e.g., some *Rallus*, *Porphyrio*, and *Fulica* spp. [Taylor 1998]). Most of these examples are from species that are considered seasonal breeders. It would be reasonable, therefore, to test whether molt in Hawaiian Moorhens tends to follow peak breeding time. Unfortunately, Hawaiian Moorhens can breed at any time of the year (Byrd and Zeillemaker 1981, U.S. Fish and Wildlife Service 2005) and, although peaks have been reported, they can occur almost any time of year. Peak breeding has been reported from March–August (Shallenberger 1977) and April–June (Byrd and Zeillemaker 1981); bimodal peaks have been reported in February and November (Nagata 1983), March and October (Chang 1990), and April and December (MDS, unpubl. data). Taylor (1998) suggests timing of molt in tropical rail species is irregular and may not be associated with end of the breeding season. Consequently, we were not able to test an *a priori* hypothesis about timing of molt relative to peak breeding, and it appears that identifying the relative timing of breeding and molt in Hawaiian Moorhens will require tracking individually marked birds.

We estimate that Hawaiian Moorhens complete their primary molt in ~30 days. This estimate is slightly higher than the 20–27 days required to complete molt for the African subspecies (Fagan et al. 1976) but is well within estimated molt rates for nine other rail species (range: 21–54 days) reported by Taylor (1998). We predict Hawaiian Moorhens are capable of flight 25 days after onset of molt if this subspecies matches flight capability of waterfowl that undergo the same molt pattern (Dean 1978). We predicted molt would be associated with a change in body condition, either poorer condition due to the costs of molt or better condition if birds added mass before molting, but body condition was unrelated to molt.

Flightlessness from simultaneous replace-
ment of primaries leaves molting birds vulnerable to predation. Moorhens typically use two escape tactics to evade predators: running into vegetation (Greij 1994) and short, eruptive flights (Bannor and Kiviat 2002). Running is unlikely to be affected by loss of flight feathers during molt because moorhens do not flap their wings during escape runs (DWD, pers. obs.). However, the inability to fly is likely to increase predation risk (McLennan et al. 1996) because short, eruptive flight is a common behavior in Hawaiian Moorhens in response to threats. In addition, Hawaiian Moorhens flap their wings to escape a predator (DWD, pers. obs.). Introduced mammalian predators, including rats (Rattus spp.), house cats (Felis catus), domestic dogs (Canis familiaris), and small Indian mongoose (Herpestes javanicus), pose serious threats to molting moorhens in Hawaii (U.S. Fish and Wildlife Service 2005). Steadman (2006) posits that as many as 1,600 flightless rail species have gone extinct in the tropical Pacific, including many as 1,600 flightless rail species have gone extinct in the tropical Pacific, including species in Hawaii, partly due to introduced predators associated with human colonization.

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Habitat Associations and Nests of Band-tailed Antbirds (Hypocnemoides maculicauda) in the Brazilian Pantanal

João Batista de Pinho,1,4 Leonardo Esteves Lopes,2 Marcos Maldonado-Coelho,3 Tatiana Colombo Rubio,1 and Bianca Bernardon1

ABSTRACT.—We studied the habitat association of Band-tailed Antbirds (Hypocnemoides maculicauda) in four forest types in the Brazilian Pantanal between 1999 and 2006. Birds were sampled with standardized mist nets during 20 months and point count censuses during 14 months. Band-tailed Antbirds exhibited a preference for seasonally flooded forests (Landi and Cambarazal) with no capture or detection in drier forests (Cordilheira and Carvoeiro), even during the wet season. We found no evidence of regular local movements between different forest types. The 21 recaptures were normally in the same forest patch as capture, indicating strong site fidelity and defense of year-round territories. The 10 nests observed were pouch shaped and constructed with plant fibers; each contained two eggs. Nests were found between January and April when the Pantanal is flooded. The unusual breeding season of the Band-tailed Antbird appears to be closely associated with the flooding regime. Received 9 January 2008. Accepted 2 June 2008.

Habitat associations of many neotropical birds are poorly known and the two species in the genus Hypocnemoides, Band-tailed Antbird (H. maculicauda) and Black-chinned Antbird (H. melanopogon), are no exception. The range of Band-tailed Antbirds, although largely confined to the southern Amazon region (Zimmer and Isler 2003), reaches the northern and northwestern border areas of the Pantanal floodplain (Dubs 1992, Tubelis and Tomas 2003). Species in the genus Hypocnemoides are known to be insectivorous, inhabiting humid forest, generally near water, where a suspended pouch nest is constructed (Davis 1949, Schubart et al. 1965, Parker 1982, Remsen and Parker 1983, Willis 1984, Terborgh et al. 1990, Zimmer and Isler 2003). Band-tailed Antbirds are normally found near water in the undergrowth of várzea and swampy forests near the wooded margins of sluggish lakes and streams, but also inhabit gallery forests (Remsen and Parker 1983, Terborgh et al. 1990, Ridgely and

1 Núcleo de Estudos Ecológicos do Pantanal Mato-grossense, Instituto de Biociências, Universidade Federal de Mato Grosso, 78075-960, Cuiabá, MT, Brazil.
2 Laboratório de Ornitolgia, Departamento de Zoologia, ICB, Universidade Federal de Minas Gerais, Avenida Antônio Carlos, 6627, Pampulha, 31270-910, Belo Horizonte, MG, Brazil.
3 Department of Biology, University of Missouri, St. Louis, One University Boulevard, St. Louis, Missouri 63121, USA.
4 Corresponding author; e-mail: pinho@cpd.ufmt.br
The climate in the area is highly seasonal. The rainy season, with rain almost daily, lasts from October to April (Tarifa 1986). The remaining months are dry and usually hot (>35–40°C). The area is subject to moderate flooding, and the flooding regime can be divided in three distinct periods: (1) flooded from January to April with water as high as 1.2–1.5 m, (2) runoff from May to August when water levels slowly decrease, and (3) low-water from September to December when water levels are relatively constant at their lowest level. The dry season (May–Sep) largely corresponds to the runoff period, not to the low-water period.

The vegetation consists of a mosaic of forest patches, savannah-like vegetation, permanent and seasonally-dry lakes, and secondary vegetation. The most common forest types are (1) Cordilheira—deciduous to semi-deciduous strips (<100 m wide) of forest that grows on sinuous remains of paleo-levees several kilometers in length, reaching 1–2 m above the surrounding seasonally inundated plains. These elevations are not subject to inundation. Typical plant species are Petiveria alliacea (Phytolaccaceae), Adelia membranifolia (Euphorbiaceae), and dense stands of a terrestrial bromeliad, Bromelia balansae (Bromeliaceae) (Nunes da Cunha et al. 2007). (2) Cambarazal—seasonally flooded semi-evergreen forests dominated by Vochysia diversgens (Vochysiaceae) (Nascimento and Nunes da Cunha 1989, Nunes da Cunha et al. 2007). (3) Landi—seasonally flooded thickets bordering shallow natural channels that provide drainage during the flood period but become dry during low-water periods. Typical plant species include Licania parvifolia (Chrysobalanaceae), Alchornea discolor (Euphorbiaceae), and Calopodium brasiliensis (Guttiferae) (Ribeiro 1999, Nunes da Cunha et al. 2007). (4) Carvoeiro—deciduous forests dominated by Callisthene fasciculata (Vochysiaceae) with mean canopy of 8–14 m in height; the soil is covered by sparse grasses with dense stands of Bromelia balansae (Guarim et al. 2000, Nunes da Cunha et al. 2007). Riparian forests were also present, but were not consistently sampled.

Data Collection.—We evaluated habitat use by Band-tailed Antbirds by mist-netting and conducting censuses in the four forest types (3 patches of each forest type, except only 2 patches in Carvoeiro). The mean (± SE) patch size of each forest type was 11.0 ± 1.0 ha for Cordilheira, 91.5 ± 2.2 ha for Cambarazal, 13.6 ± 2.4 ha for Landi, and 53.9 ha for Carvoeiro.

Mist netting (10 nets of 12 × 2.6 m, mesh size 36 mm) was conducted every month from September 1999 to December 2000, and during February, April, June, and August 2001. Nets were in the same location, and each forest patch was sampled once each month. Nets were open from 0600 to 1100 hrs, and all captured birds were color-banded. Netting effort was 3,000 mist-net hrs (3 patches × 20 months × 5 hrs per sampling period × 10 nets) in each forest type except in Carvoeiro, where netting effort was 2,000 mist-net hrs (2

RESULTS

Habitat Use.—We captured Band-tailed Antbirds in mist nets on 34 occasions (Fig. 1) with similar numbers of captures in Cambarazal (11 captures and 5 recaptures) in April, July, August, September, November, and December and Landi (11 captures and 7 recaptures) in February, March, April, May, June, August, September, October, and November. No antbirds were captured in Cordilheira and Carvoeiro forests. Capture rates were 0.0053 and 0.0060 birds/net hr in Cambarazal and Landi, respectively.

We recaptured 21 birds including data from opportunistic mist-netting with a mean interval between recaptures of 10.1 ± 2.4 months. Only two birds were recaptured in a forest patch other than where first captured (in forest patches ~800 and 3,000 m apart, respectively). No individual captured in one forest type was recaptured in a different forest type. Six individuals were captured 3–5 times in the same forest patch, suggesting site fidelity. The maximum interval between recaptures was 47 months, providing a minimum estimate of longevity for this species.

Most detections during point count censuses were in Landi (n = 15 detections at 8 different points) followed by Cambarazal (n =
7 detections at 6 points). No Band-tailed Antbirds were observed in either Carvoeiro or Cordilheira forests.

Data for both Cambarazal and Landi were pooled as there was no evidence of regular local movements between forest types. More birds were captured (or recaptured) in mist nets during the second half of the year, but censuses revealed no consistent pattern of seasonal fluctuation in abundance (Fig. 1).

**Nest Description.**—We located 10 Band-tailed Antbird nests with the first found under construction on 15 January 2006 and the last active nest, with two nestlings, found on 14 April 2006. We found six nests in Cambarazal, three in flooded riparian forest, and one in Landi. All nests were pouch-shaped and constructed with firmly-braided black plant fibers from the thin aerial roots of the cipó de arraia (Cissus spinosa and C. sicyoides, Vitaceae). Nests had an oblique entrance due to differences between the front and back of the nest (Fig. 2). All nests were pensile and suspended from near the rim that was woven onto thin (<1 cm) branches. Mean measurements \( (n = 9 \text{ nests}) \) were: 16.6 ± 0.4 cm long, 7.4 ± 0.4 cm deep (egg chamber), 8.0 ± 0.4 cm maximum external width, and 4.4 ± 0.3 cm maximum internal width.

All nests were in shrubs in flooded areas. Water levels changed considerably during the nesting period and, with one exception, all nests were no more than a few centimeters above the water (mean = 18.1 ± 2.9 cm). One nest in a riparian forest was 1.5 m above the water. Shrubs in which nests were located included Licania parvifolia (Chrysobalanaceae, \( n = 8 \)), Bauhinia sp. (Caesalpiniaceae, \( n = 1 \)), and Alibertia sp. (Rubiaceae, \( n = 1 \)). Band-tailed Antbirds generally constructed nests in moderately-open areas, apparently avoiding patches of dense vegetation. One or two old
abandoned nests were usually observed in the same tree where active nests were found, often on the same branch. A male was observed constructing its nest during the single event of nest construction observed. Two nests and two eggs were collected and deposited in the ornithological collection of the Zoological Institute of the Universidade Federal de Mato Grosso.

Eggs and Nestlings.—All clutches \((n = 10)\) consisted of two eggs with a dark overall appearance. The ground color was pinkish, and eggs were completely marbled with dark violaceous spots that completely obscured the thicker end (Fig. 2). Both collected eggs were ovoid, measuring \(14.0 \times 18.9\) mm and \(14.4 \times 19.3\) mm, and weighing 2.4 and 2.6 g, respectively.

One-day-old nestlings were completely naked with purplish-black skin and a whitish-yellow bill. The upper bill was gray and gape coloration was yellowish orange. Older nestlings, probably 1 week of age, were covered with pin feathers, but lacked downy feathers (Fig. 2). Both males and females were observed incubating and brooding.

DISCUSSION

Band-tailed Antbirds exhibited preference for seasonally flooded forests \((\text{Landi} \text{ and } \text{Cambarazal})\) and avoidance of drier habitats \((\text{Carvoeiro} \text{ and } \text{Cordilheira})\) even during the wet season. Zimmer and Isler (2003) reported similar behavior for this species, which is dependent on the proximity of water, where it forages amidst the tangles of branches common in these areas (Ridgely and Tudor 1994, Sick 1997). We observed no seasonal movements between forest types. The absence of between-habitat or long-distance movements, together with apparent site fidelity, suggests Band-tailed Antbirds defend year-round territories, a common strategy among antbirds (Greenberg and Gradwohl 1986, Skutch 1996, Gorrell et al. 2005, Duca et al. 2006).

Capture rates of Band-tailed Antbirds were relatively low, probably due to the low density in the study area. Previous studies have found the density of this species in western Amazonia to be 0.5 pairs/100 ha in a mid successional forest (Terborgh et al. 1990) and 2.5 pairs/100 ha in an early successional forest (Robinson and Terborgh 1997). We have no density estimates for our study area, but if we assume the local density was similar to the physiognomically similar early successional Amazonian forests and considering size of forest patches sampled, we would have about one pair in each \text{Landi} patch and two to three pairs in each \text{Cambarazal} patch sampled.

Capture rates were lower from January to July, a pattern similar to that also observed in the study area for resident Mato Grosso Antbirds \((\text{Cercomacra melanaria})\) (Pinho et al. 2006). Low capture rates for Mato Grosso Antbirds were probably due to a shift in activities (e.g., foraging) to higher forest strata during flooding (Jan–Apr) when water levels rise to 1.2 m (Pinho et al. 2006). This shift could explain the lower number of captures of Band-tailed Antbirds during the flooded period. An alternative hypothesis is that adults may be less mobile during these months (i.e., because their activity may be focused in the vicinity of nests and young).

The breeding period of Band-tailed Antbirds was from January through April when the study area was flooded. Most passerines in the Pantanal breed from August to December, coinciding with the start of the rainy season (Pinho 2005). Most passerines in the Cerrado and the Atlantic Forest also breed from August to December (Marini and Durães 2001, Lopes and Marini 2005, Medeiros and Marini 2007) suggesting that rain rather than flooding influences timing of reproduction. However, breeding by Band-tailed Antbirds may be triggered by the flooding regime as suggested by the unusual close association between flooding and the breeding period. To our knowledge, this is the only passerine in the study area that exhibits this distinctive reproductive strategy.

The only published data on breeding of Band-tailed Antbirds consists of records of adults feeding stub-tailed juveniles during the low-water period (Aug) in the lower Rio Javari, Brazil (Zimmer and Isler 2003), where flooding ceases in May–June (Oliveira 2007). This apparent difference in the association between flooding regime and reproductive strategy between Pantanal and Amazonia remains to be investigated. Another Band-tailed Antbird nest found in Cantão State Park \((\text{09° 16’ S, 50° 00’ W})\) in central Brazil on 22 May 2006 (T. Dornas, pers. comm.) corroborates
the atypical breeding season of this species. This nest was ~1 m high in an area subject to regular flooding (~1 m water depth when found) and contained two fully grown nestlings.

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First Record of Nest and Eggs of the Pale-naped Brush Finch
(Atlapetes pallidinucha)

Camilo A. Peraza

ABSTRACT—Few nests and eggs for the genus Atlapetes (Emberizinae) have been described. I describe the first nest and egg for the Pale-naped Brush Finch (Atlapetes pallidinucha). The nest was a bulky open cup similar to those for other species in the genus Atlapetes, but differed from that of A. melanocephalus. The egg resembled those of A. albinucha, A. leucopis, and A. latinuchus demonstrating the variability among the genus. Nesting appears to be associated with the second peak of rains of the year. Received 6 September 2005. Accepted 20 June 2008.

Little is known about the nests, eggs, young, and breeding behavior of members of the genus Atlapetes, which comprises 27 species in Central and South America (AOU 1998, Remsen et al. 2008). Published records of nests and eggs are available only for six and seven species, respectively. This information is helpful when studying systematics, phylogeny, and life-history traits between subgroups within the genus and related genera of birds (Winkler and Sheldon 1993, Collias 1997, Sheldon and Winkler 1999, Zyskowski and Prum 1999, Winkler 2000).

The Pale-naped Brush Finch (Atlapetes pallidinucha) is a common resident of temperate forests, Andean cloud forests, bushy forest edges, stunted shrubby second growth, dwarf forest, bamboo thickets, and brush up to tree line (páramo zone) from Venezuela to Ecuador and Peru. It usually occurs from 1,700 to 3,800 m above sea level, but is more common between 2,000 and 3,100 m (Paynter 1978, Hilty and Brown 1986, Ridgely and Tudor 1989, Fjeldsa and Krabbe 1990, Ridgely and Greenfield 2001, Hilty 2003). Brush Finches with enlarged gonads have been reported by Hilty and Brown (1986), and Fjeldså and Krabbe (1990) from February to September in the central and eastern Andes of Colombia. These authors also report that begging young of A. pallidinucha have been found in March (Huila, Parque Nacional Natural Puracé—pappallactae), and fledglings as well as juveniles becoming adults in January, March, and May (Cauca—pappallactae) into June (Cundinamarca—pallidinucha). The purpose of this paper is to describe the first nest and egg of the Pale-naped Brush Finch (A. p. pallidinucha) in Colombia.

OBSERVATIONS
I found an A. p. pallidinucha nest in second growth vegetation along the border of an old road (Fig. 1A) during routine bird censuses in the northeastern Bogotá, D.C. Mountains (Usaquén), Colombia (04° 41’ N, 74° 01’ W; 2,800 m elevation). The precipitation in this area is bimodal with peaks of rain in April—
May and October–November, and dry seasons in January–February and July–August (Mora-Osejo 1995). I first located the nest on 5 October 2000, although I suspected its presence on 19 September when I flushed the adult. The nest, egg, and one adult were collected on 6 October, and have been deposited in the ornithological collection of the Instituto de Ciencias Naturales (ICN), Universidad Nacional de Colombia, Bogotá (ICN-N183, ICN-H095, ICN-34501, respectively). The general vegetation around the nesting site was dense, low (<5 m) native scrub (“Matorral Nativo”) (Asociación Bogotana de Ornitología 2000) with a few dispersed plants of Cytisus monsspessulanus, Ulex europaeus, and Oxalis minutiflora.

The nest was concealed in a dense thicket of grasses, 40 cm above the ground (to the top of nest). The nest was a bulky open cup, mainly of dry twigs and grasses (Fig. 1B); the base was covered with mosses and a few dry leaves of bamboo (Chusquea sp.) were attached around the outside. The nest lining was thin, dry grass leaves that formed a tightly interwoven soft surface. Tall grasses (1.5 m high) and one bamboo supported the nest base and protected it by providing a roof-like covering. Two evident paths through the vegetation used for entrance were on opposite sides of the nest. A third entrance at the top was suspected, because the bird collected arrived at the nest even though the thicket was completely surrounded by a mist net with only a small opening close to the bamboo. The nest measurements were: external diameter = 12.0 cm, internal diameter = 6.5 cm, outside height = 10.0 cm, and depth at center = 6.0 cm. The nest contained one pale greenish blue egg covered with brownish-ocher and blackish-lilac blotches of different sizes and shapes, and concentrated around the larger end (Fig. 1C, D). The egg was 25.0 × 16.9 mm and weighed 3.45 g. It was being incubated and contained an embryo in the first stages of development (ca. stage 30, egg contents weighed 1.96 g); no other eggs were present in the oviduct of the female collected, suggesting a clutch size of one egg.

The bird collected was an adult female (100% skull pneumatization), weighing 34.7 g with a developed brood patch, little body fat,
and a stomach full of insects. Two birds (presumably the paired male and female) were present when I encircled the nest site with a mist net, and gave a long series of rapid high-pitched trills and sibilant notes at the nest site. They fluttered rapidly around the nest in apparent distraction displays but did not approach within 1 m of the nest.

Two additional pairs and a single individual carrying two long dry grass leaves were observed in the same area from 19 September to 13 October. The ICN ornithological collection houses two specimens from this locality. Both were collected on 30 October 1952 by Antonio Olives and represent a possible female (ICN-3208) and a juvenile male (ICN-3209).

**DISCUSSION**

The nest was in habitat where the species has been recorded as a common resident (Paynter 1978, Hilty and Brown 1986, Ridgely and Tudor 1989, Fjeldså and Krabbe 1990, Remsen and Graves 1995, Ridgely and Greenfield 2001, Hilty 2003). Breeding information for *A. pallidinucha*, as well as those for other species occurring in the páramo zone (CAP, unpubl. data) suggests that September to October is the breeding season, which matches the beginning of the second peak of rain in the year.

The nest placement height is one of the lowest known for an *Atlapetes* species with the exception of *A. albinucha*. Nest height placement in the genus is usually from 0 to 8 m above the ground (Table 1) with a mean and median of 1.6 and 1.1 m, respectively. This suggests members of this genus have a preference for low strata in which to build their nests (Table 1).

*Atlapetes* nests are usually bulky, open, and cylindrical to ovate cup in shape (Fig. 1B, Table 1). The construction materials and lining of the nest were similar to those reported for other species in the genus (Cherrie 1892, Blake 1956, Skutch 1967, Stiles and Skutch 1989, Salaman et al. 1998, Oppel et al. 2003, Cisneros-Palacios 2005). However, differences in nest placement and architecture could be a consequence of correlation with environmental factors (Kern and van Riper 1984, Franklin 1995) and material availability in the surrounding vegetation (Zyskowski and Prum 1999, Oppel et al. 2003).
TABLE 2. Length (L), width (W), and L/W ratio of *Atlapetes* eggs. The egg of *A. pallidinucha* was similar to those for other species in the genus. No relationship is apparent between measurements and weight of species. When \(n > 1\), data are presented as \(x \pm (\text{SD})\). Species names follow Remsen et al. (2008). NA = Information Not Available. \(\text{Footnote a}\) Data for *A. albinucha* from Sclater and Salvin (1879) (Colombia), Cherrie (1892) (Costa Rica), Blake (1956) (Costa Rica), and Skutch (1945, 1967) (Costa Rica and Guatemala); *A. leucopis* from Salaman et al. (1998) (Colombia and Ecuador); *A. latinuchus* from Sclater and Salvin (1879) (Colombia); *A. pallidiceps* from Oppel et al. (2003) (Ecuador); and *A. citrinellus* from Dinelli (1918) (Argentina), Smyth (1928) (Argentina), and Pereyra (1951) (Argentina). \(\text{Footnote b}\) Body mass data (g) are from Dunning (1993) (*pallidinucha*, *albinucha*, and *latinuchus*) and Paynter (1972) (*pallidiceps*).

<table>
<thead>
<tr>
<th>Species (\text{Footnote a})</th>
<th>(n)</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>L/W ratio</th>
<th>Body mass (\text{Footnote b})</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A. pallidinucha</em></td>
<td>1</td>
<td>25.0</td>
<td>16.9</td>
<td>1.48</td>
<td>35.50</td>
</tr>
<tr>
<td><em>A. albinucha</em></td>
<td>25</td>
<td>23.6 (0.70)</td>
<td>17.4 (0.71)</td>
<td>1.36 (0.05)</td>
<td>33.97</td>
</tr>
<tr>
<td><em>A. leucopis</em></td>
<td>1</td>
<td>27.5</td>
<td>18.5</td>
<td>1.49</td>
<td></td>
</tr>
<tr>
<td><em>A. latinuchus</em></td>
<td>NA</td>
<td>24.1</td>
<td>17.8</td>
<td>1.35</td>
<td>25.70</td>
</tr>
<tr>
<td><em>A. pallidiceps</em></td>
<td>9</td>
<td>24.0 (0.70)</td>
<td>17.8 (0.50)</td>
<td>1.35 (NA)</td>
<td>32.30</td>
</tr>
<tr>
<td><em>A. citrinellus</em></td>
<td>8</td>
<td>23.5 (1.57)</td>
<td>17.2 (0.76)</td>
<td>1.37 (NA)</td>
<td></td>
</tr>
</tbody>
</table>

Armani (1985:316) describes an apparent nest of *A. pallidinucha*, as: “En forme de coupe. Extérieur: aspect compact de feuilles sèches, lichens, racines. Intérieur: végétaux plus fins, lichens. Situé dans un arbuste bas ou un buisson épais couvert de végétation parasite.” Todd and Carriker (1922:525) reported a nest for *A. melanocephalus* as “made of grass and rootlets, domed over, and placed in a low bush or shrub.” Salaman et al. (1998: 25) reported for *A. leucopis* that “D. M. Lysinger, observed two birds carrying nesting material into a 10 cm diameter hole in a large clump of moss, ca. 8 meters above the ground.” This suggests that additional field data and voucher nests for species in the genus are needed. Data on locality are not provided by Armani (1985), no other *Atlapetes* species is known to build a domed nest or use cavities, and reported sample sizes are insufficient to detect a pattern for species, season, or locality.

Clutch size reported for *Atlapetes* species varies from one to three, but most commonly is two (Cherrie 1892, Dinelli 1918, Todd and Carriker 1922, Smyth 1928, Pereyra 1951, Blake 1956, Armani 1985, Hilty and Brown 1986, Binford 1989, Stiles and Skutch 1989, Salaman et al. 1998, Oppel et al. 2003). The egg that I found resembled those reported for *A. albinucha* in Colombia (Sclater and Salvin 1879). However, egg color is variable in *Atlapetes* ranging from completely white in *A. melanocephalus* (Todd and Carriker 1922) to pale creamy with gradation to greenish white in *A. leucopis* (Salaman et al. 1998), buffish white to light bluish in *A. pallidiceps* (Oppel et al. 2003), or whitish rosy-pink or reddish-brown in the latter species, *A. latinuchus*, and *A. citrinellus* (Sclater and Salvin 1879, Dinelli 1918, Smyth 1928, Oppel et al. 2003). Spots, blotches, and specks on eggs are also variable within the genus, and are found anywhere, when present, but principally at the larger end of the egg (Dinelli 1918, Smyth 1928), or around both poles (Oppel et al. 2003). Differences between eggs of *Atlapetes* deserve further study. There was little variation in size of the egg that I found compared with those from other *Atlapetes* species, and no evident relation was found between egg size or its length/width ratio and the body mass of species (Table 2).

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LITERATURE CITED
